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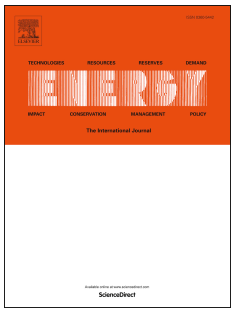

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Integrating renewable energy sources by electric vehicle fleets under uncertainty

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Abstract

Electric vehicles are one of the concepts towards green and sustainable transportation systems. However, several uncertainties with respect to electricity demand and availability of electric vehicles as well as electricity supply by renewable energy sources influence an optimal scheduling through smart charging strategies. This paper investigates the possibilities to integrate additionally loads of uncertain renewable energy sources by smart charging strategies of three different electric vehicle fleets – namely, commercial customers, commuters, and opportunity parkers. Therefore, data from an empiric field test with a public charging infrastructure in a parking garage with a photovoltaic system is taken. Various strategies are analyzed, considering the changing individual electricity demand, restrictions and parking times of electric vehicle fleets by combining a Monte Carlo simulation approach with different methodologies like a heuristic algorithm, an optimization model and stochastic programming. The numerical results indicate that the domestic photovoltaic generation of the car park can be fully used by the electric vehicle fleets for charging and the utilization of photovoltaic can be doubled when comparing uncontrolled and optimized charging strategies. The commuter fleet has the highest CO_2 emission reduction potential of all three electric vehicle fleets. Moreover, load management decreases costs, even when uncertainties are considered.

Keywords: Electric vehicle fleets, renewable energy sources, uncertainty, load management, stochastic optimization

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